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Experiment Station Work,

XXXIX.

Compiled from the Publications of the Agricultural Experiment Stations.

IMPROVEMENTS IN PEACH GROWING.
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THE FARM WOODLOT.

JANUARY, 1907.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK.[a]

IMPROVEMENTS IN PEACH GROWING.[b]

In view of the rapid decline in the peach industry in New Jersey, as well as in Delaware and Maryland, in recent years, G. F. Warren, of the New Jersey Station, undertook a careful study of the factors contributing to this condition and the possible means of overcoming it.

According to the United States census reports, there were in the United States 53,886,000 peach trees in 1890, and 99,919,000 in 1900, showing an increase of over 85 per cent. During this time the number in New Jersey decreased from 4,414,000 in 1890 to 2,747,000 in 1900, a loss of 38 per cent. Only three States in the Union showed a decrease, New Jersey, Delaware, and Maryland; every other State increased its peach orchards. In 1890 these three States had 28 per cent of all the peach trees in the United States. In 1900 they had only 9 per cent. There has, in fact, been a panic among the growers.

The immediate cause of this condition has been the San José scale. But this has not been the only trouble. As is usual when any serious enemy threatens a crop, all troubles are charged to this pest. Damages from starvation, lack of tillage, borers, leaf-curl, and brown-rot are very frequently all bunched and charged to the account of the scale. * * *

In the fieldwork a study was made of soils, tillage, fertilization, spraying, varieties, diseases, insects, and other questions.

The more important suggestions to growers with a view to overcoming present unfavorable conditions are thus summarized:

First year.—Select a well-drained field, one that also has good air drainage, higher than the surrounding land if possible.

If possible have the field some distance from other orchards.

Lime the soil before planting, unless sure that it is not needed.

Buy good thrifty trees of a nurseryman who is not only honest, but intelligent—one who knows the diseases of the peach, so that he will not be propagating diseased trees.

Remove the borers, if there are any.

Prune to a whip, or nearly so.

Dip in lime, sulphur, and salt before setting.

Plant far enough apart so that it will be easy to drive through when spraying.

Fertilize well and plant corn or other tilled crops between the trees.

Prune in June, so as to start the formation of the heads.

Remove the borers in the fall.

Spray the next spring.

Subsequent years.—Prune every year, doing some heading-in as well as thinning out.

Spray thoroughly every spring before the buds swell.

Till every year, beginning early in the season and stopping early.

Fertilize liberally with phosphoric acid and potash, particularly with potash. If barnyard manure is used, also apply muriate of potash.

Remove the borers every fall and again in the spring.

After having given this good care, promptly remove all sick trees.

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[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from New Jersey Stas. Bul. 197.

Thin the fruit when necessary.

Grade the fruit carefully. Put up the first quality in a package that differs from that used for the poorer grades.

If the peach orchard is neglected in order to care for the corn crop, the profits must be expected to come from the corn.

MULBERRIES.[a]

The mulberry is but little cultivated as a fruit in America. There is very little market demand for it and as a home table fruit it is sweetish and considered rather insipid, though some enjoy it as a fresh dessert fruit. It has, however, several valuable features which, according to a recent bulletin by H. H. Hume and F. C. Reimer, of the North Carolina Station, makes it worthy of more extended culture in the home grounds than is at present given to it

To begin with, the fruit will grow successfully on nearly any kind of soil, doing best probably on moist sandy loams. The tree is a rapid, vigorous grower, requires practically no culture, makes an ornamental shade tree, and some of the better varieties will yield from 10 to 12 bushels of fruit per season. A valuable feature of the fruit is that it ripens almost continuously over a period of two to four months every year. The fruit is greatly relished by hogs and poultry. Birds prefer it to cherries or strawberries, and when planted in the vicinity of these fruits it serves as a protection to them.

From the standpoint of fruit production the North Carolina Station recommends the following varieties for planting about the farm: New American, Black English, Stubbs, and Townsend of the black-fruited varieties; and White English and White Russian of the white-fruited sorts. Of the New American, Professor Bailey, in an early bulletin of the Cornell Station, states that it is the best sort known for the Northern States. The tree is a hardy, vigorous grower, productive, and bears continuously from late June until September. Large trees will produce 10 bushels of fruit in a season. The fruit varies in length from 1 to 2 inches and is a glossy black when ripe. It is frequently sold for the Downing, but is superior to that variety.

The Black English is considered by Hume and Reimer as one of the most satisfactory varieties for planting in North Carolina. The tree is a strong upright grower, and bears a large amount of fruit of medium size from May to July. The flavor is sweetish and the quality only fair. The Townsend is considered by the same authors as the earliest fruiting variety now grown, ripening in Florida from the latter part of March through April. The trees are very prolific, fruiting abundantly in the nursery row one year from grafting. It is of medium size, 1 by ½ inch, black, with a sweetish flavor not differing from other mulberries.

[a] Compiled from New York Cornell Sta. Bul. 46; North Carolina Sta. Bul. 194.

The Stubbs is a wide-spreading, vigorous, prolific variety. The fruit is very large, varying from 1½ to 2 inches in length and from ½ to ⅝ inch in diameter, with a bright deep red color, becoming black, subacid, and of excellent quality. The ripening season in North Carolina is from June to August.

Of the white-fruited varieties recommended by the North Carolina Station, White English is considered by far the best. It is a heavy bearer, producing sweet, medium-sized fruits of good quality from May to July. The White Russian seems to be a small, bushy, very hardy sort, and quite productive. The fruit is of medium size, white, very sweet, and of fair quality. The season is from May to June.

In addition to the use of mulberries as a fruit, the leaves constitute the chief food of the silkworm. In the West and Northwest also the Russian mulberry (*Morus alba* var. *tartarica*) has proved excellently adapted for planting in shelter belts and hedges and also for fence posts and fuel. This variety is very hardy against both cold and drought and makes a splendid growth there. It is the species commonly used there as a stock on which to propagate the more fruitful varieties. The Russian mulberry possesses particular merit as a hedge plant in cold regions from an ornamental standpoint. There is also a number of ornamental forms of the mulberry, including weeping sorts, which are extensively used in ornamental plantings.

Mulberries are propagated from seeds or by grafting, budding, layering, and cuttings. In propagating the plant for use in hedges or shelter belts the plants are grown from seeds, but for fruit purposes grafting, cutting, or layering must be resorted to in order to produce varieties true to name.

Most species of mulberries are easily propagated by means of cuttings. And while the most satisfactory and most economical plan is to use one-year-old branches for this work, twigs of the current season's growth may also be used. Cutting wood may be removed from the trees soon after the leaves have dropped. Select well-matured, well-developed one-year-old branches from one-quarter to five-eighths inch in diameter. Cut these into pieces, each being provided with from three to six good buds. In eastern North Carolina the cuttings may be planted immediately after removal from the trees, but in the colder sections it is usually best to tie them together in bunches of twenty-five and store them in damp sand in a cellar or pit until spring.

The cuttings are set out in well-prepared soil, making an opening in the ground with a spade, firmly pressing the soil about the base of the plants, and covering up to the top bud. It takes longer to produce trees by this method than by budding or grafting. Bench grafting by either the whip, cleft, or saddle method is used; or the trees may be grafted out of doors, using either the cleft or whip method. In the South, Multicaulis mulberry stem or root cuttings are used almost exclusively as stocks, while in the colder West and Northwest, Russian mulberry seedlings are used as stocks.

In the orchard, large growing trees like New American, White Eng-

lish, and Black English should be planted about 30 feet apart, and for such varieties as Stubbs and Hicks 35 feet in the row is close enough between trees. The trees should be set out in the usual manner by cutting off all broken and bruised roots, shortening in the longer roots somewhat, and cutting back the top.

According to Hume and Reimer—

> The mulberry needs little or no cultivation. When planted in chicken yards or where hogs are allowed to run and root, no extra cultivation need be given. They will thrive in soddy land; but generally the trees do better where the soil is stirred or worked, as in hog pastures. If any cultivation is given it should be shallow, as the roots spread out near the surface of the ground. Deep plowing should not be practiced. The mulberry requires little or no pruning. But as the wood is rather brittle and the branches are easily broken by sleet storms, the stubs which are left should be cut off close up in the trunk and the broken branches cut smoothly off at the ends.

Wild mulberries have been used since the earliest times in America; Hariot, in his Narrative of the First Plantation of Virginia, which was first printed in 1588, mentions that the Indians used mulberries, crab-apples, and huckleberries, such as were known in England; but the mulberry has occupied a less important place in the list of foods than most other edible native fruits and berries. The quality of the wild fruit is known to vary greatly, some trees yielding berries of excellent flavor and appearance while others produce small and very inferior berries. The fruit of cultivated and improved varieties of mulberries is much superior to the native fruit, and has been long appreciated though never common in the United States. Old gardens in Eastern and Southern States and New England often contain a mulberry tree, and the fruit has been used in a limited way for the table and for preserving.

In flavor and appearance, mulberries, particularly the dark varieties, resemble blackberries more nearly than they do any of the other common fruits. The flavor is sweet and rather aromatic, though not as pronounced as that of the blackberry, and to some palates it is always accompanied by a suggestion of the peculiar and elusive odor noticed when mulberry leaves are crushed.

The color of the dark-fruited varieties is intense, and as the berries are soft and easily crushed they stain the fingers or table linen very readily.

According to analytical data reported some years ago by a German investigator, cultivated mulberries contain 84.7 per cent water, 0.4 per cent protein, 14.3 per cent carbohydrates, and 0.6 per cent ash. According to American analyses, blackberries, on an average, contain 86.3 per cent water, 1.3 per cent protein, 1 per cent ether extract, 10.9 per cent carbohydrates, and 0.5 per cent ash, values which in general are much like those quoted for mulberries. In the case of blackberries, about 6 per cent of the total carbohydrates has

been found to be invert sugar, and in the case of mulberries about 9 per cent. Of course, the kind and amount of sugar would be influenced very greatly by the degree of ripeness.

Mulberries can be used as a dessert fruit, and also for making pies, puddings, jellies, jams, etc., in the same way as more common berries. The expressed juice is bottled to some extent in Europe, like raspberry juice and other fruit juices, and mulberry wine is also made. The long fruiting season and the generous yield are points in favor of the mulberry for table use.

ALFALFA CULTURE IN THE EASTERN UNITED STATES.[a]

While alfalfa is quite generally grown west of the Missouri River it has not made similar progress in the eastern sections of the country, although attempts to cultivate it were made a century ago in New York and other Eastern States. For many years the successful culture of alfalfa was considered as limited to the region west of the Mississippi and south of the Minnesota-Dakota line. In more recent years, however, its culture has steadily spread eastward and northward until the crop is grown with more or less success in all of the Eastern States and in such northern latitudes as Minnesota, Wisconsin, northern New York, Vermont, Ontario, and Quebec. The experience gained in most of the early trials, and even some later ones, was not as a rule encouraging, and the efforts to grow alfalfa were generally abandoned. Interest in the crop, however, was reawakened later on, and during recent years many culture tests have been conducted by the eastern experiment stations and by this Department. One of the principal reasons why alfalfa grows more successfully over extensive regions in the West is thought to be the greater uniformity of soil conditions over larger areas than in many of the Eastern and especially the Atlantic coast States. Another reason is that the movement in alfalfa culture in this country progressed from west to east, and as the earlier settlers of the West located in the most favorable spots the culture of alfalfa had the advantage of being introduced where it had the greatest chance of succeeding, while in the more thickly settled States it is often tried under conditions unfavorable to its growth. Although the more or less general introduction of the crop in certain sections has brought many failures, it has also demonstrated that there are numerous localities, and often considerable areas, over which the crop may be grown with success in the East. The great value of alfalfa for feeding purposes and soil

[a] Compiled from Alabama College Sta. Bul. 127; Delaware Sta. Bul. 55; Illinois Sta. Bul. 76; Indiana Sta. Bul. 101; Maine Sta. Bul. 126; Maryland Sta. Bul. 85; Michigan Sta. Bul. 225; Mississippi Sta. Rpt. 1904, p. 13; New Jersey Stas. Buls. 148, 190; New York Cornell Sta. Bul. 237; Ohio Sta. Circ. 49; Pennsylvania Sta. Bul. 79; Vermont Sta. Bul. 114; Virginia Sta. Bul. 154; Wisconsin Sta. Bul. 121.

improvement makes it well worth while to continue culture experiments for the purpose of ascertaining under what conditions and in what localities its general culture may be attempted with promise of success.

The wide adaptability of alfalfa and the possibilities of its culture east of the Mississippi are indicated by the measure of success which has attended the more recent attempts to grow the crop in Alabama, Delaware, Illinois, Indiana, Maine, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Vermont, Virginia, and Wisconsin under a great variety of soil and climatic conditions. The more important practical facts brought out in investigations by the experiment stations in some of these States are summarized below.

Experiments with alfalfa have been carried on for a number of years in Alabama by farmers and by the experiment station in cooperation with farmers and with this Department. Summing up the results, J. F. Duggar says in a recent bulletin of that station:

> Alfalfa is a perennial leguminous plant, useful for hay, feeding green, pasturage, and for soil improvement. In nutritive qualities alfalfa stands in the front rank, and when fed to farm teams the ration of corn can be greatly diminished. On suitable soil the yield of hay exceeds that of any other hay plant. On prairie soils in Alabama yields of more than 3 tons per acre were in two instances obtained within seven months after sowing the seed, and the yield continues to increase for several years. Farmers report 3 to 5 tons per acre as the usual yield of hay per acre on prairie soil in Alabama, and in a number of instances these yields are greatly exceeded.
>
> Alfalfa makes an unrivaled hog pasture, and is also recommended as a pasture plant for horses and mules. Cattle and sheep sometimes bloat when grazing on alfalfa. Pasturing, especially during the first year, injures and sometimes kills alfalfa.

In experiments made by A. T. Neale, of the Delaware Station, alfalfa gave much larger yields of feed than crimson clover or cowpeas, even when harvested within five months after seeding. This, however, is considered an unusual result.

The earlier attempts to grow alfalfa on Illinois soils failed because, as C. G. Hopkins, of the Illinois Station, points out, the alfalfa bacteria were generally lacking in the soils, and in some cases lime and phosphoric acid were needed. When these deficiencies were supplied alfalfa has generally been successfully grown in the State on well-drained soils.

Experiments reported by A. T. Wiancko and M. L. Fisher, of the Indiana Station, show that a good stand of alfalfa may be obtained with proper inoculation on almost any of the soils of Indiana, but especial' on the more open soils.

Experiments in different parts of Maine, reported by C. D. Woods and J. M. Bartlett, of the Maine Station, showed such a low degree of success that "the station does not advise anyone in this State to grow alfalfa at present, except in an experimental way."

Summing up the results of observations and experience during a number of years, W. T. L. Taliaferro, of the Maryland Station, says:

Numerous attempts have been made in recent years to grow alfalfa in Maryland. For the most part these efforts have been failures, and the impression has been pretty generally formed that our soil and climate are not adapted to its growth. Some of the efforts have, however, succeeded, enough of them and in such widely separated localities as to show clearly that the successful growing of alfalfa in this State is mainly a question of local soil selection. There is no doubt that with more experience in handling it and a better knowledge of the conditions it requires there are in every county in Maryland thousands of acres which might be, and ultimately will be, put into alfalfa.

Trials of alfalfa were begun by the Michigan Station as early as 1889. Of this work C. D. Smith says:

The station has distributed alfalfa seed for trial to over 150 farmers. The United States Government has also distributed seed to many farmers in the State, and the records of these plats have been turned over to this station. Of 76 reports from farmers who have tried alfalfa, 32 record absolute failures, due generally to winterkilling; 24 record partial success for a single year; 16 record success for two or more consecutive years.

The principal cause of failure is winterkilling. Whether varieties sufficiently hardy to generally withstand the severe winters of the State can be found is yet to be determined, according to Professor Smith.

E. R. Lloyd, of the Mississippi Station, reports that 2 acres of alfalfa at that station pastured 14 pigs two months and gave 6,541 pounds of hay.

In a bulletin of the New Jersey stations G. A. Billings makes the following statement:

A few years ago it was supposed that alfalfa was a plant which could be successfully grown only by irrigation. We find to-day, however, that it can be grown on varying conditions of soil and climate, from the bottom lands of the Red River in Louisiana and the Yazoo delta of the Mississippi in the South, to Minnesota, Wisconsin, New York—even as far north as Ottawa and southern Quebec, and from the Atlantic to the Pacific oceans. * * * A five years' experiment at this station gave an average yield of 19.32 tons of green forage per acre. The largest yield, namely, 26.6 tons, was grown the third year. Reports from different parts of this State indicate that farmers are following the suggestions of this station, and are successfully growing the crop. The acreage is rapidly increasing, and the stand on newly seeded fields is excellent.

The New Jersey Station experiments show that on account of its large yield and high nutritive value, especially protein content, alfalfa may be profitably used to partly replace purchased concentrated feeds in rations for farm animals.[a]

The New York Cornell Experiment Station has experimented with alfalfa on the college farm at Ithaca and in cooperative trials throughout the State and has secured results affording suggestions helpful to Eastern alfalfa growers.

During the winter of 1903–4, which was unusually severe, consider-

[a]U. S. Dept. Agr., Farmers' Bul. 251, p. 26.

able damage was sustained by the alfalfa fields of New York. Of 86 responses to a circular of inquiry sent out by the station 67 reported damages to the crop during the winter. The replies further indicate that alfalfa was grown on a wide range of soils, including those with heavy clay and hardpan subsoils. Good success was reported in a number of cases on fields with heavy subsoil, but it was observed that the fields in which the losses were reported as considerable all had heavy clay or hardpan subsoil, the heaviest losses being sustained on the soils with the heaviest subsoils, while the fields from which little or no damage was reported nearly all had porous subsoils. Only one of the fields reporting no injury had a hardpan subsoil. From the results of this inquiry it is concluded that while alfalfa does succeed in some instances on lands with more or less impervious subsoils it is much more likely to be injured by severe winter seasons than on lands underlaid with subsoils of a greater porosity. The failures of the first attempts with the crop are attributed to its growth upon lands unsuited to its culture and to improper management due to inexperience in handling it.

The results secured in 1904 and 1905 corroborated the conclusions of the previous year by emphasizing the importance of suitable soils, their thorough preparation, their adequate fertility, their freedom from weeds, the use of good pure seed, the application of lime in most cases, and inoculation with the proper nitrogen-gathering bacteria.

C. G. Williams, of the Ohio Station, states that, while the acreage devoted to alfalfa in Ohio is not large, it is increasing quite rapidly. He believes that the culture of alfalfa "may be undertaken with reasonable hope of success upon almost any well-drained limestone soil in the State. Its success upon other soils is not as well assured, although the indications are that with proper treatment, including a liberal application of lime, it can be made to do fairly well in most sections.

"Drainage, either natural or artificial, is the first essential. An excess of water in the soil is fatal to alfalfa. While it will stand an overflow of several days' duration at certain seasons of the year, it will not thrive upon land where the water-level is close to the surface, or where water does not drain off rapidly."

G. C. Watson, of the Pennsylvania Station, reports varying degrees of success in attempts to grow alfalfa in that State during the last six or eight years, but states that many of the trials were made under conditions not well suited to the growth of the crop. "Under favorable conditions alfalfa yields a most satisfactory crop for soiling and for hay."

In 56 trials in different parts of Vermont reported by J. L. Hills and L. R. Jones, of the Vermont Station, 12 were classed as permanent successes, the rest as failures or temporary or partial successes. The larger proportion of the successful trials occurred in the Champlain

Valley, where soil (limestone) and climatic conditions are more favorable than elsewhere.

In a recent bulletin of the Virginia Station, by A. M. Soule and Meade Ferguson, it is stated that "alfalfa is being grown with success in various parts of Virginia, and the indications are that it will do well in humid climates providing the soil is brought into suitable conditions for its growth."

A bulletin of the Wisconsin Station, by R. A. Moore and others, states that "alfalfa can be grown successfully under proper conditions in all counties of Wisconsin. * * * No forage plant has so preeminently come to the front in the State during the past five years as has alfalfa." In experiments at the Wisconsin Station alfalfa gave much larger yields and more protein per acre than clover, timothy, or brome grass.

The essentials of successful alfalfa culture in the Eastern United States are here briefly summarized from the station publications above referred to. Deep well-drained soils with porous subsoils are best suited to alfalfa. Observations made by the New York Cornell Station indicate that the upland stony and shaly loam soils in the northern two-thirds of the State are better suited to alfalfa than the soils in the southern third, which are generally compact shaly silt and clay loams with a dense subsoil. Good yields of alfalfa have also been secured on gravels and gravelly loams. The soil should be well supplied with lime (although applications of this substance have not always proved beneficial), as well as with potash and phosphoric acid, and if it is not well inoculated there should also be an abundance of readily available nitrogen present. The soil may be inoculated (1) by means of infected soil, or (2) by the use of pure cultures of the nitrogen-fixing organisms. In the first method soil from a field in which alfalfa has grown and produced abundant root tubercles is scattered over the field at the rate of 100 pounds per acre just before the seeding. The second method is fully described in a Farmers' Bulletin of this Department.[a] In experiments made by the New York Cornell Station the first method was almost uniformly successful, leading to the conclusion "that this method of inoculation when needed will not fail of giving results unless the soil is in such condition that the bacteria can not live in it."

It is absolutely essential that the young plants especially should have the most favorable conditions possible for growth, for as G. A. Billings of the New Jersey Station says:

> The young alfalfa plant is one of the weakest among farm crops, grows slowly, is easily checked or killed by weeds, or by unfavorable conditions of the soil, weather, or treatment. The seed bed is therefore of prime importance, and the greatest care must be taken to give the young plants plenty of available plant food and best soil conditions for the first year of their growth.

[a] U. S. Dept. Agr., Farmers' Bul. 239.

The treatment of the field for the season preceding should be such as to effectually subdue all weeds, and cause the sprouting and destruction of weed seeds in the soil. Care should be taken not to introduce them with manure. Apply manure, therefore, on the previously tilled crop or after the alfalfa crop is established.

The soil should be thoroughly prepared—this is important—to secure a good stand. For spring planting, it is preferable to plow in the fall. If, however, alfalfa is to be planted on land freshly plowed, the surface should be firmed with a roller, then fined to a depth of 3 inches to prevent loss of moisture. Provided the surface is kept pulverized, the longer the seeding is delayed after plowing the better, and many failures may be due to careless work at this time.

Summer or fall seeding following thorough tillage often proves preferable to spring seeding, which is more likely to be choked out by weeds. Somewhat heavier seeding (20 to 30 pounds per acre) than is common in the West has generally been found preferable for the Eastern States. Liberal applications of barnyard manure are especially beneficial to alfalfa.

With early seeding on very weedy land it may be beneficial to seed with a nurse crop; with late seeding the nurse crop may be omitted.

OAT CULTURE IN THE SOUTH.[a]

It is generally believed that the culture of oats is not so well adapted to the Southern States as to more northern latitudes. In most of the Southern States the average yield of the crop ranges from 12 to 25 bushels per acre, while the average yield for the entire country for 1905 was 34 bushels, and the average yield in many Northern States is from 30 to 40 bushels and even more per acre. The total yield and acreage is also largely in favor of the North.

R. J. Redding, of the Georgia Station, points out that the poor results with oats in the South are due to a large extent to poorly selected seed and careless methods of culture, but that one of the main reasons for its limited culture in that region "is the alleged uncertainty of the oat crop, because of the danger of winterkilling, if the seeding is done in the fall, and the liability to rust or injury from drought, if sown in the spring." He, however, gives it as his opinion, "that under proper conditions, most of which are under our control, or subject to modifying precautions, the oat crop can be made a more certain crop than corn."

Experiments made by several Southern experiment stations have shown that at least much better results with oats than those indicated by the crop statistics can be secured in many localities. Experiments extending over a period of ten years have recently been summarized by J. F. Duggar in a bulletin of the Alabama Station, and the results obtained are here briefly reviewed to show by what

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[a] Compiled from Alabama College Sta. Bul. 137; Alabama Tuskegee Sta. Bul. 8; Arkansas Sta. Bul. 66; Georgia Sta. Bul. 44; Louisiana Stas. Bul. 72; South Carolina Sta. Bul 103.

methods an improvement in yield may be effected and the culture of the crop generally advanced.

In 1905 Alabama produced 3,165,574 bushels of oats on 191,853 acres, the average yield per acre being 16.5 bushels. Professor Duggar urges an increase in the acreage devoted to the crop and believes that the average yield may be more than doubled at slight expense by employing the proper methods. The different factors entering into the problem are time and manner of sowing, varieties to be grown, and the fertilizers to be used together with the methods of their application.

It is pointed out that among the numerous varieties of oats, comparatively very few have shown themselves well adapted to the Gulf States, the standard southern varieties being Red Rust-Proof, Appler, Culberson, Burt, and Turf or Gray Winter. The last-mentioned variety is also known as Virginia Gray. In tests conducted at the station, Red Rust-Proof, also known as Texas Rust-Proof, and regarded as the standard variety for the Gulf States, gave the best general results. Appler, a selection from Red Rust-Proof, in three tests yielded 6 per cent more grain than the parent variety, and Culberson, also apparently a strain of Red Rust-Proof, ranked equal to its parent in merit. Turf, or Gray Winter, gave an average of only 59 per cent as much grain as Red Rust-Proof when sown as late as November and apparently did not equal this variety when sown in its regular season in September or October. Turf oats sown in the spring was an entire failure. While Turf oats is hardier than Red Rust-Proof, it is not considered preferable for fall sowing, where the Red Rust-Proof ordinarily succeeds. Burt and May (apparently the same variety) when fall sown and after passing through a mild winter produced 89 per cent as much grain as Red Rust-Proof and 93 per cent as much when both varieties were sown in the spring. Burt is a spring variety and is seldom sown in the fall. During the past eleven years Red Rust-Proof grown at the station was practically all winterkilled but once, while after other trying seasons fair yields were obtained, although the stand of the crop had been reduced.

In experiments by C. L. Newman, of the Arkansas Station, "three varieties of fall-sown oats gave an increased yield of 75.2 per cent over twenty varieties of spring-sown oats. Culberson and Virginia Gray (Winter Turf) oats gave highest yield from fall sowing and averaged over 40 bushels per acre. The varieties giving best returns from spring sowing were Burt, Clydesdale, Culberson, Negro Wonder, Rust-Proof, Virginia Gray (or Winter Turf), and White Maine, all of which gave an average yield of more than 30 bushels per acre."

The general outcome of a series of experiments by the Alabama Station bearing on the time and manner of sowing confirm the results of similar experiments by the Georgia Station, and was that

fall sowing gave much better returns as regards winterkilling than spring sowing. The results obtained in experiments during seven different years show that red Rust-Proof sown in November gave an average increase in yield of 11.3 bushels per acre over crops of the same variety sown in February. This represents a profit of $5.65 per acre, or an increase of 73 per cent, due to fall sowing. In these experiments the average date of fall sowing was November 17, but other tests have shown that this is too late for maximum yields, and that sowing in October is likely to give larger yields and to produce hardier plants. October sowing is recommended, although it is believed that satisfactory yields may be secured by sowing on any date from September 1 to November 15. Sowing in October has the advantage of enabling the plant to develop a strong root system before winter sets in, and thus making it better able to withstand severe weather. The advantages of fall sowing are enumerated as follows: (1) A much larger yield, even after deducting the losses from partial winterkilling; (2) the utilization of poorer land by the fall-sown crop; (3) the employment of teams at a time when they are not needed in preparation of land for cotton or corn, and (4) earlier maturity of fall-sown oats, permitting the use of the crop and the use of the land at least two weeks earlier than when oats are sown after Christmas. The first few days of February are considered best for spring sowing in the latitude of the Arkansas Station. Deep plowing and thorough preparation of the seed bed are especially urged by this station among others.

The method of sowing oats found by the Alabama Station to be highly satisfactory and most effective in reducing or preventing winterkilling is much the same as that recommended by R. J. Redding, of the Georgia Station, several years ago, and consists in opening deep furrows 18 to 24 inches apart and drilling the seed and fertilizer in the bottom of these furrows, barely covering the seed with the earth falling into the furrow as the one-horse planter and fertilizer distributor passes along. The primary object of the method is to prevent the young plants from being heaved by alternate freezing and thawing. As Director Redding states in a bulletin of the Georgia Station—

> The plants come up 1½ to 2 inches below the general surface, and the "crown" of each plant is formed and established, say, 2 to 2½ inches below the general surface. The winter rains, light freezes, and thaws gradually but only partly fill in the open furrow, and the more vital and sensitive parts of the plants are left at the original depth, below the reach of even very severe freezes.

For four years the Alabama Station compared this method with broadcasting, and also with a modification consisting in nearly or quite filling the deep furrows after sowing, with results generally favoring seeding in partly filled furrows.

> For well-drained soils there are decided advantages in drilling fall-sown oats in deep furrows, especially when the winter proves severe. It is advisable, where practicable,

to run the rows perpendicular to the line of the coldest winds, which would give the rows a direction from southeast to northwest, or east and west.

These recommendations are in accord with Director Redding's results, from which he concludes "that the ideal direction would be northeast and southwest, in order to protect the plants, by means of the wall of earth, against the northwest wind."

On fields in which the young plants had been heaved by alternate freezing and thawing the Alabama Station secured good results by using the land roller when the soil was in proper condition and not too wet. The purpose of this treatment is to press the exposed crowns of the heaved plants back into the soil in order to facilitate the formation of new roots and the continuance of growth.

Fertilizer tests conducted by a number of experiment stations have shown that nitrogenous fertilizers, particularly nitrate of soda, are especially effective on oats. The Alabama Station found such fertilizers more profitable than phosphate or potash on the sandy and loamy soils of that region, but it is recommended that on such soils at least 100 pounds of phosphate per acre be applied at the time of sowing oats. It was further shown that nitrate of soda was more effective than cotton-seed meal and the latter than cotton seed. The Georgia Station found that "cotton-seed meal is an excellent fertilizer for oats on ordinary old lands," but that top-dressings of nitrate are advisable. Professor Duggar advises that where cotton seed or cotton-seed meal is used, the application be made at the time of sowing, but that nitrate of soda at the rate of 60 to 100 pounds per acre be given as a top-dressing in March after growth has begun. Barnyard manure greatly increased the yield of oats in the Alabama experiments, and also exerted an influence on the following crop: In one experiment 43.1 pounds of nitrate of soda and 103 pounds of acid phosphate, representing a total cost of $1.93, were required to produce the same increase as 1 ton of fine, fresh, unleached horse manure. As shown in 13 tests with nitrate of soda, the yield and total profit per acre increased with the quantity applied up to 200 pounds per acre. The cost of nitrate of soda required to produce 1 additional bushel of oats was 14.5 cents from the use of 63 pounds per acre, 17.7 cents from the use of 100 pounds, and 21.1 cents from the use of 200 pounds. The smallest application gave a profit over the cost of fertilizer of 249 per cent; the application of 100 pounds, a profit of 206 per cent on the cost of the fertilizer; and the application of 200 pounds, a net profit of 140 per cent—the money profits per acre being $4.73, $6.19, and $8.40 for the 3 applications, respectively.

No nitrogen need be purchased for oats, provided the oats be sown after a crop of cowpeas, velvet beans, peanuts, or soy beans, all of which crops, whether only the stubble or the entire growth was plowed under for fertilizer, afforded an increase in the suc-

ceeding oat crop of from 6.2 to 33.6 bushels per acre. From 5 to 15 bushels increase in the succeeding oat crop is considered an average result of the use of the stubble or vines of leguminous crops employed as fertilizer.

The station was successful in preventing smut in the crop by soaking the seed in a mixture made up in the proportion of 1 ounce of formalin to 3 gallons of water.

The work of the experiment stations referred to would seem to demonstrate that oats could be grown to greater extent with profit in the South, provided, as Professor Duggar says, "farmers will make the two following innovations in the usual method of caring for the crop: (1) Sowing in the early or middle fall, (2) applying nitrate of soda as a top-dressing in March, or sowing on land where a soil-improving crop, like cowpeas, has recently grown." The certainty and profit of the crop will be still further increased by more attention to selection of varieties and seed, thorough preparation of land, methods of seeding, and protection from smut.

IMPROVEMENT OF GRASS LAND.[a]

In a bulletin of the West Virginia Station, J. H. Stewart and Horace Atwood report trials of a system of manuring by which "an unfertile upland meadow was made to produce an average yield for six years of more than three tons of hay per acre, the yields gradually increasing from a little more than 1½ tons per acre the first year to a maximum of more than 5½ tons of hay per acre the last year."

The field used in this experiment has been used for the production of various crops from the time when this section of the country was first settled, and as no commercial fertilizer, and only a very limited amount of stable manure, had been applied to it, the readily available fertility of the soil had been nearly exhausted.

For the first year's experiment manure was applied during the preceding winter (1899–1900) to two-thirds of the field at the rate of twenty-five loads per acre.

The manure was obtained from livery stables in Morgantown and was spread on the meadow directly from the wagon. Just before the grass began to grow in the spring, the stable manure plat was thoroughly harrowed with a smoothing harrow so as to break all the lumps and distribute the manure uniformly over the surface of the ground. The remaining third of the field received an application of 200 pounds of sodium nitrate per acre, applied with a grain drill in the latter part of April.

The manure cost 50 cents per load at the stables, and about $1 per load when spread upon the field. The sodium nitrate cost $45 per ton. * * *

Early in the autumn of 1900 the entire meadow received an application of 400 pounds per acre of acid phosphate. In the winter the stable manure plat received a further dressing of twelve loads per acre of manure, while early in May the commercial-fertilizer plat received a dressing of 125 pounds of sodium nitrate, 125 pounds of acid phosphate, and 72 pounds of potassium sulphate per acre. * * *

The third year of the test the stable-manure plat received an application of ten loads of manure per acre. It was harrowed thoroughly in March and then rolled. The fer-

[a] Compiled from West Virginia Sta. Bul. 101.

tilizer was applied to the commercial-fertilizer plat April 19, at the rate of 110 pounds of acid phosphate, 80 pounds of sodium nitrate, and 40 pounds of potassium sulphate per acre. * * *

The fourth year of the test the stable-manure plat received a dressing of twenty loads per acre of manure applied in October and November. As in former years, this plat was harrowed thoroughly in the spring and rolled. The commercial fertilizer was applied to the other plat at the rate of 400 pounds of sodium nitrate, 800 pounds of acid phosphate, and 150 pounds of potassium sulphate per acre. This was applied as a top-dressing April 20. * * *

The fifth year of the test both plats received the same kind and amount of fertilizer as in the preceding year. The commercial fertilizer was applied April 11, and the stable manure during the fall and winter of 1903–4. * * *

The sixth year of the test the stable-manure plat received a dressing of fifteen loads of manure per acre applied in the autumn of 1904. As in previous years, this plat was thoroughly harrowed in the spring. The commercial-fertilizer plat was fertilized the same as the year before, namely, at the rate of 400 pounds of sodium nitrate, 800 pounds of acid phosphate, and 150 pounds of potassium sulphate per acre. This mixture was applied with a grain drill, April 21, 1905.

The grass grown was mainly timothy, and the hay crops were sold at prices ranging from $12 to $16 per ton, averaging nearly $15 for the whole period of the experiments. The results for the six years are summarized in the following table:

Results of 6 years' experiments in manuring a meadow.

Year.	Yield of hay per acre on plat fertilized with—		Value of hay per acre on plat fertilized with—		Cost of fertilizer per acre on plat fertilized with—		Value of crop less cost of fertilizer per acre on plat fertilized with—	
	Stable manure.	Commercial fertilizer.	Stable manure.	Commercial fertilizer.	Stable manure.	Commercial fertilizer.	Stable manure.	Commercial fertilizer.
	Pounds.	*Pounds.*						
1900	3,775	3,232	$28.31	$24.24	$25.00	$4.50	$3.31	$19.74
1901	7,219	6,095	54.14	45.71	14.70	8.15	39.44	37.56
1902	7,961	5,602	58.08	41.59	10.00	3.49	48.08	38.10
1903	7,411	7,312	55.56	57.01	20.00	18.15	35.56	38.86
1904	10,588	8,088	76.79	60.66	20.00	18.15	56.79	42.51
1905	11,315	7,955	80.68	59.16	15.00	18.15	65.68	41.01
Averages	8,044	6,380	58.92	48.06	17.45	11.76	41.47	36.29

The stable-manure plat gave an average yield of 1,664 pounds of hay per acre more than the commercial-fertilizer plat; yet on account of the extra cost of the manure as compared with the commercial fertilizer, the value of the crop, less the cost of the fertilizer, was only $5.18 larger per year. However, under ordinary farm conditions, the cost of a two-horse load of manure spread upon the land is far less than $1 per load, so in reality the difference in profit is considerably larger than is shown by the table. In addition to this difference the stable-manure plat is in a far better condition, agriculturally, at the end of the sixth year than the commercial-fertilizer plat. The soil of the former is full of decomposing vegetable matter, and is soft and yielding to the tread, while the soil of the commercial-fertilizer plat is hard and compact. The open and porous soil of the stable-manure plat enables this soil to store up more moisture, so that a crop growing thereon would be less likely to be injured by drought than is the case in the other instance.

However, both systems of manuring were highly profitable and

show that "large crops of grass can be grown upon soils of this class, provided sufficient plant food is supplied for the needs of the crop."

Incidentally, it was observed that stable manure "applied to meadow land in the fall and thoroughly harrowed in the spring becomes so disintegrated and incorporated with the surface of the soil that it is not raked up with the hay when the hay is harvested."

SUCCOTASH AS A SOILING CROP.[a]

This term, originally applied by the North American Indians to a mixture of green corn and beans prepared for human food, has in recent years come to be used also to denote mixtures of some leguminous crops, such as peas or beans with corn and one or more other cereals grown as soiling crops.

In view of the fact that numerous mixtures of this kind have been tried in different parts of the country with varying success, R. S. Shaw, of the Michigan Station, has made a series of experiments to determine the most satisfactory rotation of mixed soiling crops for swine and one which would cover the greatest possible portion of the year.

The first mixture, grown in 1903, consisted of corn, peas, oats, and barley. Though this combination produced a large tonnage of green food, it made but one crop in the season, as all of the plants in the mixture failed to make a second growth after having been cut or grazed off. With the object of securing a second growth in the season of 1904, the mixture was changed to the following, viz.: Corn, peas, oats, rape, and millet. This combination was successful in producing a second crop of rape and millet when the first crop was cut with the scythe, but not when closely grazed off. Within eight weeks from the time of the first cutting this second crop was nearly knee high; but it was mostly rape, as the millet could not keep pace with it in growth. The success thus achieved in securing a second crop of rape and millet created the desire to combine some leguminous plant with the rape in place of the millet. As a result the four sowings of the spring of 1905 were made up as follows, viz.: Corn, peas oats, rape, and clover.

The full value of this mixture has not yet been determined, but Professor Shaw is of the opinion that it "is an extremely useful combination and that it can be produced as regularly and successfully as any other crop or mixture if properly handled."

He has found it especially valuable as a soiling crop for dairy cows because of the fact that it fills in a gap between the possible use of green clover and green corn, and also highly satisfactory for young calves being housed during the heat of the summer.

Though the first attempt was to use this mixture as a forage crop for swine, it has not proved to be so valuable for that purpose as was expected. * * * When the succotash was grazed off by swine the losses were heavy from the trampling and wallowing of the animals; in fact, so much so that it had to be hurdled off, giving them access to but a limited area every few days, and this is a somewhat expensive and troublesome method. When cut, hauled, and fed in the hog lots or pens there was little or no loss. When the rape and clover plants were bitten off close to the ground by hogs many of

[a] Compiled from Michigan Sta. Bul. 235.

them failed to grow again; when cut higher with a scythe they did not fail to grow. Succotash may be objected to for the dairy cow because of the large amount of water it contains, but it nevertheless furnishes the succulence so necessary to supplement her ration while on dry and exhausted pastures. This food was used for the college dairy herd during the season of 1905 between the time the silage was exhausted and green corn became available. The composition of succotash does not vary greatly from that of green corn in the earlier stages, when used for soiling purposes. The question naturally arises, Would it not be better practice to supplement the failing pastures with silage rather than succotash? We should answer yes, providing one has the silage, but at the present time all dairymen are not possessed of silos and most of those in use are generally empty long before midsummer. Should succotash be grown for such emergencies and not needed, it can be cut and cured for hay when the oats are in the milk or dough stage. The small amount of rape in the first cutting has not tainted the milk so far as used.

The second growth of rape and clover must needs be less of a certainty than the first crop of the original mixture, as favorable conditions for growth usually diminish as the season advances, owing to greater heat and lack of moisture. A lodged crop can not remain in that condition long without injuring the clover and rape; for their benefit the crop should be cut as quickly as possible. If succotash is grown to any great extent for soiling purposes it should be sown at two or three different dates, the first late in April or early in May, the others following at intervals of ten days or two weeks. From the different dates of seeding some one or more of the lots is almost sure to produce a second growth suited for sheep or swine pasture and probably for some other classes of live stock also. The ability to secure a crop of clover on the same ground the next season, for pasture or soiling, is at present uncertain, but is well worth trying for.

The conditions and methods of culture suited to succotash are described by Professor Shaw as follows:

The ground upon which this crop is grown must be rich. We do not believe large tonnages can be secured from poor land except in unusual seasons when the rainfall is large and favorably distributed. It is not a difficult matter to properly enrich sufficient ground for the crop of succotash. A small area only is necessary, say from one to three acres, to tide the average dairyman over from clover to corn on a failing pasturage. Manure can not well be used to better advantage than on this area. We have found that the manure for this crop should not be buried too deep, for the crop should be induced to start and grow quickly; it is short-lived. Our best results have come from spreading a good coating of heavy manure (not strawy) on the land after plowing and before fitting for seeding; this manure is not allowed to lie on the surface of the ground, but is worked into and incorporated with the top two or three inches of soil by means of the disk and harrow. This plan almost insures a quick and vigorous start of the small seeds, such as clover and rape. After the seed bed has been thoroughly prepared, sow a good seeding of rape and clover mixed, broadcasting it, and then follow with the seed drill burying the mixture of corn, peas, and oats at the proper depth; the drill will cover the small seeds previously sown on the surface. In general the grain mixture should be sown at the rate of about two bushels per acre.

In the experiments reported a mixture of equal parts of rape and clover was sown at the rate of 3 quarts per acre, the rest of the seeding consisting of a mixture of equal parts of corn, oats, and peas.

TANKAGE AND BONE MEAL FOR HOGS.[a]

The widespread interest in by-products of animal origin as supplements to corn in swine feeding led the Michigan and Nebraska experiment stations to undertake several tests to determine whether

[a] Compiled from Michigan Sta. Bul. 237; Nebraska Sta. Bul. 94.

tankage, one of the most important of such materials, and ground bone can be profitably fed.

Tankage is usually prepared from refuse materials from slaughtering, such as digestive organs and their contents, flesh scraps, and some blood, and condemned carcasses which can not be used for human food, by cooking under steam pressure and then drying and grinding until almost as fine as middlings. The tankage used in the Nebraska tests is described by the company producing it as "a concentrated protein meal made from fresh, wholesome pieces of meat trimmed from beef carcasses. It looks much like dark-colored wheat shorts, is shipped in 100-pound sacks, and will keep indefinitely under average conditions of dry storage." The tankage used in the Michigan experiments was guaranteed to contain 60 per cent protein, 10 per cent fat, and 6 per cent phosphates. It was rich in flesh-forming materials and fat, as well as in bone-building material, which is true of tankage generally.

In the first test at the Nebraska Station hogs averaging 170 pounds in weight made an average gain of 65 pounds each in eight weeks on soaked corn, 5.3 pounds of feed being required per pound of gain, and the cost of a pound of gain being 3.76 cents. In the case of a similar lot fed 95 per cent soaked corn and 5 per cent tankage, the average gain was 81 pounds per head, the feed required per pound of gain being 4.6 pounds and the cost 3.6 cents. On a ration of 90 per cent corn and 10 per cent tankage the average gain in six weeks was 73 pounds per head, the cost of a pound of gain being 4.3 cents and the feed required per pound of gain 5.2 pounds. The pigs were sold for $4.90 per 100 pounds and E. A. Burnett, who carried on the experiments, calculated that the lowest returns per bushel of corn eaten was 47 cents on the ration containing 10 per cent tankage, and the largest return, 57 cents, on the ration containing only 5 per cent tankage.

In a second test, which was made with lighter hogs, the average weight being 144 pounds, the gain on corn alone averaged 71 pounds per head in the eight weeks of the test, on the lighter tankage ration 85 pounds, and on the heavier ration 86 pounds. The feed consumed per pound of gain with each tankage ration was 3.7 pounds and with the soaked corn only 4.2 pounds. The cost of feed per pound of gain on the lighter tankage ration was 2.9 cents, on the heavier tankage ration 3.1 cents, and on soaked corn only 3 cents. The calculated return per bushel for corn eaten was 98 cents in the case of the lighter tankage ration, this value being 20 cents greater than in the case of the lot fed no tankage, and 13 cents greater than in the case of the heavier tankage ration.

When shelled corn was fed instead of soaked corn eight pigs, averaging 67 pounds in weight, fed corn and shorts, 4:1, gained 42 pounds

per head in eight weeks. With both tankage rations the gains averaged 58 pounds per head. With these rations 3.5 pounds of feed was required per pound of gain, and on corn and shorts 4.6 pounds. The gain was most cheaply made on corn with 5 per cent tankage, costing 2.7 cents, and was most expensive on corn and shorts, costing 3.4 cents.

In the first of the tests some green sorghum was fed, and in the other cases the pigs were pastured on alfalfa, but no account was taken of the green feed eaten.

The experiments with relatively mature animals all showed that the addition of 5 per cent tankage to the ration produced cheaper gains than when 10 per cent tankage was used. With young pigs the gains were made on smaller amounts of food when the larger amount of tankage was added to the ration, but the high cost of the tankage has made the smaller amount of tankage more profitable. * * *

A notable advantage in the feeding of tankage is seen in the more rapid gains made by the hogs and the consequent shortening of the feeding period.

Another argument for tankage is that it is a concentrated protein food. Only a small amount is required to produce the result desired.

In all the experiments made at this station, the hogs fed tankage consumed more feed, made larger gains, and were not easily put off feed, while the hogs fed straight shelled corn were easily thrown off feed after the first six weeks, consumed less feed, and made slower gains. From the limited test made we advise adding the tankage to the soaked corn just before feeding, rather than mixing with the corn before soaking and allowing the tankage time to soak and possibly to become rancid before feeding.

In a test which was undertaken primarily to ascertain the effects of feeds of animal origin on the strength of bones both tankage and ground bone were used. For twelve weeks one lot was fed soaked corn, a second lot soaked corn with 10 per cent tankage, a third soaked corn with 10 per cent ground bone, and a fourth soaked corn with 25 per cent shorts. For the following four weeks 10 per cent of the corn was replaced with alfalfa hay, but the pigs did not relish the hay, and so the original ration was resumed for five weeks. At the beginning of the test the pigs weighed about 60 pounds each. Considering the whole period, the lots fed corn and corn and shorts gained, respectively, 114 and 132 pounds per head, while those fed tankage and ground bone gained, respectively, 163 and 164 pounds per head. Three of the largest and best hogs in each lot were slaughtered. The average slaughtered weight on corn was 192 pounds, on the tankage ration 247 pounds, on the ground-bone ration 257 pounds, and on the corn and shorts ration 210 pounds.

Tests of the strength of the bones showed that in every case the bones of the hogs fed the grain ration were not as strong as those fed the ration containing animal products. "The feeding of tankage or ground bone to young growing pigs produces a very marked effect on the strength of bone when compared with a corn ration, and its influence is still marked when compared with corn and shorts on alfalfa pasture."

In the Michigan Station tests, the special problem under consideration was the possibility of substituting tankage for skim milk, since, as pointed out by R. S. Shaw, who carried on the work, so much skim milk is now supplied to cheese factories and condensed milk factories, and to supply the demands of cities and towns, that on many farms there is a scarcity of it for feeding young calves and pigs.

In one of the tests with young pigs corn meal, middlings, and tankage, 3:3:1, mixed with water was compared with the same grain ration mixed with skim milk.

In the other tests a ration of middlings and corn meal, 2:1, with the addition of one-eleventh of tankage wet up with water was compared with the same grain ration mixed with skim milk in the proportion of 1 pound of meal to 3 pounds of milk.

On the tankage rations the average daily gain was 0.98 pound and the feed consumed per pound of gain 3.14 pounds. On the meal and skim milk rations the average daily gain was 1.08 pounds per head and the feed required per pound of gain 2.48 pounds of meal and 5.67 pounds of skim milk. In a check test covering ten weeks, in which two lots of 5 pigs each were fed middlings and corn meal, 2:1, mixed to a thick slop with water, 4.09 pounds of meal were required per pound of gain, the average daily gain being 0.8 pound.

The results indicate "that tankage can be used successfully as a substitute for skim milk in the ration for the growing pig from weaning time on," and "that a slightly greater proportion of tankage than one-eleventh of the ration could be fed, increasing the gains somewhat, and still keeping within the cost of production of the skim-milk ration."

In tests with fattening hogs on corn meal and tankage in the proportion of 5:1 and 9:1 compared with rations of corn meal only and with rations of middlings and corn meal, 2:1, with and without the addition of one-eleventh of tankage, the average daily gain per hog on the tankage rations was 1.19 pounds and on the rations without tankage 0.98 pound. The average cost of a pound of gain with tankage was 4.44 cents and without tankage 4.86 cents.

"The gains were greatest in every case where tankage was used in the ration, and this was more and more noticeable as the feeding period was prolonged. * * * In general, the figures given indicate that tankage can be used to good advantage in the ration for the fattening hog as well as for the growing pig."

The favorable results thus obtained at the Nebraska and Michigan stations with animal by-products in hog feeding are in accord with those reported by the Indiana and Iowa experiment stations and summarized in an earlier bulletin of this series.[a]

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[a] U. S. Dept. Agr., Farmers' Bul. 169, p. 29.

GRINDING CORN FOR HOGS.[a]

For the past nine years the Wisconsin Experiment Station has been conducting tests to determine whether grinding corn for hogs is desirable. In the tests previous to 1903–4[b] middlings were fed with the corn. That year corn was fed alone, but the results were so unsatisfactory as regards thrift, appetite, gains, and feed consumed per pound of gain that it was not considered desirable to omit the middlings in subsequent years.

The results have varied a little from year to year, but considering the average of all the tests 117 hogs fed dry shelled corn and wheat middlings made an average gain of 96.8 pounds each, while an equal number fed corn meal and wheat middlings gained 110.9 pounds each, the feed required per pound of gain in the two cases being 5.19 pounds and 4.88 pounds. In other words, for each pound of gain the hogs fed shelled corn required 0.3 pound more grain than those fed the corn meal. The saving from grinding, therefore, has amounted to 5.7 per cent. Whether it will pay to grind corn in order to effect a saving will necessarily depend upon two factors, namely, the price of corn and the cost of grinding. When these factors are known the possible saving from grinding can be learned from the following table:

Saving effected by grinding corn for fattening hogs.

	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Value of corn per bushel	25	30	35	40	45	50	55	60	65	70	75
Amount saved by grinding	1.4	1.7	1.9	2.2	2.5	2.8	3.1	3.4	3.7	3.9	4.2

When corn is worth only 25 cents per bushel the saving from grinding amounts to only 1.4 cents, not enough to pay for the grinding unless cheap power is available. As corn advances in price it will be noticed that the saving per bushel increases practically three-tenths of a cent with each 5 cents' advance in the price of corn. Should the price of corn be as high as 75 cents per bushel the saving by grinding would amount to a little over 4 cents per bushel.

DIPS AS LICE KILLERS.[c]

The harmful effects of infestation with lice are perhaps not fully recognized by stock raisers, and consequently farm animals are often allowed to go without assistance in ridding themselves of these pests. Experiments on the treatment of lice on hogs have been made by a number of the experiment stations and by the Bureau of Animal Industry of this Department, and the results, summarized in a bulletin of the Bureau by E. C. Stevenson, show in general the high practical efficiency of crude or pure kerosene or kerosene emulsion for this purpose.

[a] Compiled from Wisconsin Sta. Rpt. 1905, p. 16.

[b] Wisconsin Sta. Rpt. 1904, p. 20.

[c] Compiled from Oklahoma Sta. Bul. 72; U. S. Dept. Agr., Bureau of Animal Industry Bul. 69.

In recent experiments with dips for destroying lice particularly on hogs, L. L. Lewis, of Oklahoma Experiment Station, compared the effectiveness of kerosene or crude oil in various forms and certain proprietary dips of a coal-tar origin. It was soon found that the results obtained from a practical use of coal-tar dips on hogs, under ordinary farm conditions, were not as satisfactory as generally obtained in laboratory experiments. Even in laboratory tests, however, kerosene emulsion containing 5 per cent of kerosene was more effective than 3 per cent coal-tar preparations.

A very satisfactory and inexpensive dipping device was found in a wallowing vat placed so as to be constantly accessible to the hogs. This vat had a depth of about 14 inches and was kept constantly filled with water, being cleaned occasionally and carrying on the surface a gallon or more of crude oil. It was found that the hogs kept themselves free from lice by voluntary immersion in this vat. Coal-tar preparations used under the same conditions did not give the same results, and the hogs were never free from lice after treatment with the proprietary remedies.

One of the defects of the proprietary remedies as compared with crude oil, kerosene, or kerosene emulsion was found to lie in the fact that the proprietary remedies were not nearly so effective in destroying the eggs of the lice as were the various forms of petroleum. According to the experience of Doctor Lewis, if it is desired to spray cattle or treat them with a brush or sponge, kerosene emulsion may be used freely without any fear of harm. For this purpose the emulsion should contain one-half pound of hard soap and 2 gallons of a cheap grade of kerosene in 8 gallons of water.

The Bureau of Animal Industry gives the following directions for preparing this emulsion: Add one-half pound of hard soap (one-half bar of common soap) to 1 gallon of water and boil until the soap is dissolved. Remove from the fire and add 2 gallons of kerosene and agitate vigorously until an emulsion is formed which is gelatinous on cooling. Dilute with warm water to the required strength. The effectiveness of the emulsion is said to be increased by adding 3½ pounds of pyrethrum which is allowed to soak in the kerosene twenty-four hours before the latter is used in preparing the emulsion.

DIGESTIBILITY OF FISH AND POULTRY.[a]

A recently published report of the Connecticut Storrs Experiment Station contains results of a series of studies carried on by R. D. Milner to determine the digestibility of fish and poultry. Salmon was selected as a type of a relatively fat fish and cod steak as a type of lean fish. Similarly in the experiments with poultry, duck

[a] Compiled from Conn. Storrs Sta. Rpt. 1905, p. 116.

was chosen because it is rich in fat and chicken because the fat content is low. The salmon and chicken used were canned products, the cod and duck were fresh goods. Some simple foods like bread, milk, butter, and sugar were eaten with the special foods studied, the whole constituting a simple yet palatable ration.

The four young men who served as subjects were in good physical condition with apparently normal digestion. Two of them had served as subjects in previous digestion experiments, and the remaining two from their laboratory experience fully understood the nature and requirements of such experiments.

Each experiment covered three days and all the food consumed and the feces excreted were analyzed. The urine excreted on the final day of each experimental period was also weighed and its heat of combustion determined. From the data thus obtained the digestibility of the diet as a whole and that of the fish and poultry alone was calculated in the usual manner. The following table shows the average coefficients of digestibility of the fish and poultry:

Coefficients of digestibility of fish and poultry—Average of four tests.

Kind of food.	Protein.	Fat.	Energy.
	Per cent.	*Per cent.*	*Per cent.*
Salmon (canned)	96.23	97.01	85.63
Cod	95.93	97.40	80.27
Chicken (canned)	96.74	97.13	85.35
Duck	94.66	97.32	91.14

Examination of the results of the individual tests showed that the variations in the coefficients of digestibility were comparatively small; the average for protein of the different foods, for instance, varied less than that of the protein of the same food for the four subjects, being for cod and salmon about 96 per cent, for chicken a little higher, and for duck somewhat lower. The greatest variation was noted with the energy, the highest values being obtained with the salmon and the duck; that is, with the foods containing the largest proportion of fat and hence having the highest energy value.

This may be an indication that the availability of the energy is highest in foods containing a large amount of fat, though the data at hand are not sufficient to warrant too sweeping deductions.

From the results of sixteen experiments in which canned salmon, fresh cod, canned chicken, and roast duck made up in turn a considerable portion of the diet, it appears that these foods are very completely digested, the coefficients of digestibility being approximately those previously found for other animal foods. The foods containing a considerable proportion of fat were apparently as completely digested as those in which the percentage of fat was relatively small. The number of kinds of poultry and fish investigated and the number of experiments carried on with each are too small to warrant further conclusions.

HONEY VINEGAR.[a]

In one of the timely hints for farmers issued by the Arizona Station, A. E. Vinson gives directions based on recent work at the station for making vinegar from honey. It seems that most of the vinegar is supplied to the Territory by eastern makers and the price is abnormally high. Very large quantities of honey are produced in the Territory. This has been used in part by the farmers as a source of vinegar, but the quality of the vinegar made by the usual processes followed by farmers is not up to the standard, and the time required to produce vinegar is so long that many are deterred from making it on a small scale.

The first thing to be considered in making honey vinegar is to secure the complete conversion of the sugar in the honey to alcohol. As is well known, this is accomplished with the aid of yeasts working in the diluted liquid.[b] These yeasts require not only organic but also mineral matter and nitrogen for their best growth. The fermentation starts off much more promptly also if a yeast cake is added.

Honey diluted with ordinary water appears to be lacking in nutrients for the yeast, especially in nitrogen, potash, and phosphoric acid. According to the investigations at the station these materials can best be added to the diluted honey in the form of ammonium chlorid and potassium phosphate, using 1 part each to 1,000 parts solution.

Unfortunately, potassium phosphate is seldom to be had in the drug stores, and we must rely on other chemicals to take its place. This is best done by using sodium phosphate and potassium sulphate; of each about one part per 1,000. This combination is much cheaper than the rather expensive potassium phosphate and is to be recommended where large amounts of honey vinegar are made. These chemicals can all be obtained in large quantities for about 15 cents per pound. The small producer, who can not afford to buy large amounts at wholesale, will experience much difficulty in getting potassium sulphate, but experiments in this laboratory have shown that potassium bicarbonate, a chemical to be had in every drug shop, can be substituted with nearly as good results. The chemicals are absolutely harmless, and are in no sense of the word to be considered adulterants. Care should be taken to secure well water of good quality, preferably hard, but not too salty.

When a barrel of honey vinegar is to be made for family use or the small producer the following formula is suggested: Strained honey, 40 to 45 pounds; water, 30 gallons; ammonium chlorid, 4 ounces; potassium bicarbonate, 2 ounces; sodium phosphate, 2 ounces. To this should be added about one-quarter of a cake of dry yeast softened in lukewarm water. If the material is now kept at a temperature of 65 to 75° F. the fermentation will be very rapid.

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[a] Compiled from Arizona Sta. Timely Hints for Farmers, No. 60.

[b] See article on Cider Vinegar, U. S. Dept. Agr., Farmers' Bul. 233, p. 28.

The chemicals for making 30 gallons will cost about 25 cents in a small way, but on a large scale not more than 10 cents. Somewhat larger amounts of potassium bicarbonate and sodium phosphate would give even better results, but the amounts are here cut to the minimum to bring the cost low enough to make it profitable.

In from three to four weeks all visible fermentation will have ceased and the yeast settled out. Now rack off the wine, add 10 gallons of good vinegar, containing a little mother, and let stand undisturbed in a place having as nearly as possible an even temperature of from 75 to 80° F. The acetic fermentation may be started by floating mother or the scum from an older cask on the surface of the mixture by means of thin cork shavings. Carried out in this way and at a suitable temperature (temperatures over 85° F. will retard the process and cause loss of both alcohol and acid) a good honey vinegar can be produced in from four to six months.

SUGGESTIONS FOR THE MANAGEMENT OF THE FARM WOODLOT.[a]

Several of the experiment stations, usually in cooperation with the Forest Service of this Department, are studying certain phases of forestry, more especially from the practical standpoint of the farmer and owner of small areas of woodland. Farmers' holdings are small individually, but in the aggregate they are of tremendous importance to this country. Something like two hundred million acres of land—about one-third of all the forests of the United States—are held in farmers' woodlots. At the same time the country is rapidly using up the supply of standing timber. Lumber prices are rising rapidly, and will surely continue to rise. Since wood for every purpose is sure to become more valuable as time passes, it is worth while for the far-sighted farmer to see to it now that his woodlot is so handled as to yield in future the largest possible supply of this slow-growing crop.

The following suggestions regarding the management of the farm woodlot have been compiled from the publications of the experiment stations and of the Forest Service. The farmer should aim to maintain, and, if possible, improve the value of his woodlot while using it. Too often it deteriorates under use. If he cuts the best trees or those which are easiest to work up, he leaves the "weed trees," as foresters call them—that is, the useless trees, which crowd out and displace good trees—to reproduce. One aim should be to keep up, and, if possible, increase the supply of the kinds of trees which it pays best to grow. While a large part of the product of the woodlot will generally be firewood, it will pay the farmer better to grow as large a product as possible of railroad ties, telegraph and telephone poles, and saw logs.

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[a] Compiled from Connecticut State Sta. Bul. 154; Massachusetts Sta. Bul. 97; New Hampshire Sta. Bul. 95, and Connecticut Board of Agriculture Rpt. 1905. See also U. S. Dept. Agr., Forest Service Bul. 42, on the woodlot; Farmers' Bul. 173, Primer of Forestry, and work of the Division of Forestry for the Farmer in the Yearbook of the Department of Agriculture for 1898.

A high quality of product will depend not only upon the kinds of trees, but on the size of the trees. A large tree is worth much more proportionately than a small tree, because of the better quality of its product.

The farmer should always see to it that his land is fully stocked. The average woodlot is understocked. This means that the land is partly idle. If an old pasture is coming up slowly to forest growth, very likely trees can be profitably planted. The farmer will gain by this, although he may not himself live to cut the timber, for land fully stocked with young timber will be salable at a much higher price because of its prospective value. This is already true in many regions. It will be far more generally true as timber increases in value.

The farmer should cut his trees so as to benefit the forest. The branchy, wide-spreading tree, the crooked tree, or the tree of a kind which is not likely to prove salable, is the best for him to cut when he is getting out his supply of firewood. This gives room for the better trees near by to grow, as well as opening the ground for reproduction. Before a tree is cut it should be noted what trees will take advantage of the cut. Care should be taken in cutting to do as little harm to young growth (often regarded as "brush") as possible. This may sacrifice just the trees which should have grown up and set back the next cutting a dozen or fifteen years: Sprouts from the stump grow much more rapidly than trees from seedlings, because they do not have to establish a root system of their own, but are virtually branches of the old tree, which has been pruned back to the ground. Almost all hardwoods (that is, broadly speaking, deciduous trees as distinguished from evergreens) sprout from the stump. Consequently where these make up a woodlot by far the largest volume of wood can be secured under a system of sprout or "coppice" management. But the vigor of sprout growth declines as the root systems age; therefore new seedlings are needed in a sprout forest to replace the enfeebled stock.

The farmer should inform himself not only as to what kinds of trees will be most profitable in the long run but also as to what the requirements of the different kinds are. One tree will grow where another will not. It is necessary to know about each kind, and how to get the conditions which will make it grow best. Woodlots to which the principles of forestry have never been applied very commonly offer a good chance for "improvement cuttings." The purpose of such cuttings is to secure needed material, utilize timber which would otherwise go to waste, and make room for other trees to grow. In making improvement cuttings the farmer should look especially for two classes of trees in addition to those already indicated as desirable for removal. These are (1) overmature trees

which are beginning to decay and will rapidly lose their value; and (2) "suppressed" trees—that is, those whose crowns have been overtopped by their nieghbors so that they can no longer compete for room. It is not worth while, however, to remove suppressed trees if the material which they furnish will not pay for cutting.

Fully stocked stands should be thinned when the trees are large enough to make a thinning pay for itself. The idea in thinning is to remove the weak and inferior trees in order that the better trees may develop more rapidly and perfectly.

The following illustrations, used by A. F. Hawes, State forester of Connecticut, in a recent bulletin of the Connecticut State Station,

A B

FIG. 1.—A group of chestnut sprouts before (A) and after (B) thinning.

show some actual examples of thinning chestnut-sprout timber in Connecticut:

In figure 1, trees 79, 80, and 81 are straight and thrifty, with diameters from 5 to 7 inches and heights from 40 to 43 feet. The crowns of 77 and 78 form a mass of foliage, the removal of which will help 79 and 81. The appearance of this group after thinning is shown in figure 1, B.

In figure 2, poles 10, 13, 14, and 15 are especially promising, being from 5 to 7 inches in diameter and having heights of from 40 to 47 feet. No. 12, although 47 feet high, has a crown too small to supply it with food. Its diameter is only 4.7 inches. By its removal the other three of the group, which are all over 6 inches in diameter,

will receive more light and increase their diameter more rapidly. The removal of trees 8 and 9 affect, respectively, 13 and 10. The appearance of this group after thinning is shown in figure 2, B.

In cutting mature timber the chief concern is to secure satisfactory reproduction as soon as possible. The "group method" is generally the best adapted for farm woodlots. Select a spot, or several spots, if one will not supply what is wanted, where the forest crop is ripest—possibly overripe—and clear, with due care for young growth,

A B

FIG. 2.—A group of chestnut sprouts before (A) and after (B) thinning.

a hole in the forest, taking care that the diameter of this hole is not more than two or three times the height of the surrounding trees. Gradually widen these holes by cutting in concentric rings about them until the whole area has been cut over.

It should be borne in mind, however, that if in any one year more wood is cut than grows on the whole woodlot in that year, the necessary wood capital is diminished. Where the whole area is cut over before the part cut first has had time to grow to maturity, a period will have to follow during which the woodlot will stop paying dividends.

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